

RESEARCH ARTICLE

PHYSICOCHEMICAL STATUS OF GANGOTI DAM AT MAN TEHSIL, SATARA (M.S.) INDIA

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Abstract:

The present study is aimed to document the current status of water quality of Gangoti Dam located near Gangoti village of Tal. Man, Dist. Satara to record various point and non-point sources of pollution into it. Surface water samples were analysed for pH, Temperature, Turbidity, Colour, Total Dissolved solids (TDS), Dissolved oxygen (DO), Biochemical oxygen demand (BOD), Carbon dioxide (CO₂), Chemical oxygen demand (COD), Orthophosphate (O-PO₄), Nitrate–nitrogen (NO₃–N), and Silicates (SiO₄-Si). Result of the study reveals that, water quality parameters of Gangoti dam shows seasonal variation and follow the permissible limits prescribed by World Health Organization. Therefore, at present water of the dam is suitable for its designated uses such as drinking, fishing, recreation, aquaculture, and irrigation.

Keywords: Gangoti Dam, Physico-Chemical Analysis, Seasonal Alterations.

Introduction:

Freshwater is crucial for various organisms, including humans, who rely on it for essential needs such as drinking water, irrigation, industrial processes, and recreational activities (Sivakumar *et al.*, 2018). Rivers, lakes, wetlands, dams, and ponds are among the vital freshwater resources that support daily human activities and provide indispensable services. The quality of these resources is a key indicator of a country's sustainable development (Wu *et al.*, 2017; Kapani *et al.*, 2024).

Water is essential to sustain life, and a satisfactory (adequate, safe and accessible) supply must be available to all. Improving access to safe drinking-water can result in tangible benefits to health. Every effort should be made to achieve drinking-water that is as safe as practicable (Saima *et al.*, 2024). Safe drinking-water, as defined by the guidelines, does not represent any significant risk to health over a lifetime of consumption, including different sensitivities that may occur between life stages. Those at greatest risk of waterborne disease are infants and young children, people who are debilitated and the elderly, especially when living under unsanitary conditions (WHO, 2011). Due to nutrient enrichment

(eutrophication) due to anthropogenic activities, majority of these resources are undergoing deterioration of water quality and degradation of the entire ecosystem (Udayashankara *et al.*, 2013).

Due to rapidly increasing population, exponential industrialization and urbanization, etc. various water bodies are exposed to environmental degradations. This leads to reduction in Dissolved Oxygen (DO) level which ultimately disturbs the ecological balance of the lake and finally leads to eutrophication in water bodies (Parul *et al.*, 2022). Eutrophication in these resources is rapidly increasing due to discharge of nutrient-rich effluents originating from industry and agriculture in basin areas. Freshwater quality is deteriorating because of rapid industrialization, expanding populations, and by poor management leading to severe environmental degradation (WWF, 2004).

Construction and operation of dams are among the primary strategies for water resources management (Cymes and Glinska-Lewczuk, 2016). Dams are applied for supplying water demand in agriculture, drinking, fish farming, flood control, and energy production (Singodia *et al.*, 2024). Anthropogenic activities such as the entry of urban and rural wastewater, livestock and metal factories effluent, and production of pesticides and fertilizers can contaminate dam water (Yuni *et al.*, 2024). Therefore, to understand the physico-chemical properties of the dam water are vital for the application of dam water resources for its designated uses (Hamid *et al.*, 2021; Fashagba *et al.*, 2024).

Increasing water demands and consumptions for human activities along with decreasing natural water resources and environmental pollutions have made water quality assessment as an important issue in recent years (Vatitsi *et al.*, 2024). In this context, monitoring the quality of water, especially drinking water resources, at regular times will be incumbent (Jiangang *et al.*, 2022). Today, there are concerns for surface water quality since being degraded by anthropogenic activities, such as urban, industrial, and agricultural developments accompanied by increasing water-resources exploitations and natural alterations caused by erosion, weathering, and precipitation processes of crustal materials (Anoushirvan *et al.*, 2018; Singh *et al.*, 2024).

The water quality has been described as, “it is the physical, chemical, and biological characteristics of water”. Water quality is a measure of the condition of water relative to the requirements of one or more biotic species and/or to any human need or purpose (Nayla, 2019). Assessing the water quality parameters is needed to develop best planning and management for water resources. Water quality has an important impact on health, and poor quality of water will cause various disease outbreaks such as diarrhoea, cholera, dysentery, typhoid and guinea worm infection and it is an increasingly important public health issue (Siti *et al.*, 2015).

Water quality is considered to be a key contributor to both health and the state of disease for humans. Surface water quality in a region is largely influenced by both natural processes and by anthropogenic inputs (Rui *et al.*, 2020). Human activities mainly impact surface water quality through atmospheric pollution, effluent discharges, the use of agricultural chemicals, in addition to the increased exploitation of water resources (Yannawar *et al.*, 2013; World Water Quality Alliance, 2021). This has generated great pressure on aquatic ecosystems, resulting in a decrease of water quality and biodiversity, loss of critical habitats, and an overall decrease in quality of life for local inhabitants. It is therefore essential to prevent and control water pollution and to implement regular monitoring programs (Zhao

et al., 2012).

Water Quality can be defined as the chemical, physical and biological characteristics of water, usually in respect to its suitability for a designated use. Water quality standards are put in place to ensure the suitability of efficient use of water for a designated purpose (Potharaju and Aruna, 2023). Water quality analysis is important to check its suitability for the designated use; to monitor the efficiency of a system for water quality maintenance; to check whether upgradation / change of an existing system is required; and to monitor whether water quality is in compliance with rules and regulations. It is extremely necessary in the sectors of public health and industrial use (Bhateria and Jain, 2016; Roy, 2019).

Baring few reports on water quality assessment of dams such as Yannawar et al (2013) on Nagzari Dam; Sayyad (2020) on Jayakawadi dam; and Vankore and Nikam (2024) on Kalamavadi dam; meagre information is available on water quality of dams from Maharashtra. Also, no earlier work is available on the monitoring of water quality of dams in Satara District and nearby region. The district's economy relies heavily on agriculture. However, the excessive use of pesticides in maintaining agriculture leads to agricultural runoff, contaminating freshwater resources. Untreated sewage effluents further contribute to pollution. Consequently, the local freshwater resources face potential anthropogenic threats, jeopardizing its ecosystem services and biological processes. To date, no investigation has explored the physicochemical characteristics and water quality of Gangoti dam. Hence the present study is undertaken to assess the water quality variables of Gangoti Dam, Tal.–Man, Dist.–Satara as a baseline work from the area.

Material and Methods:

Study Area:

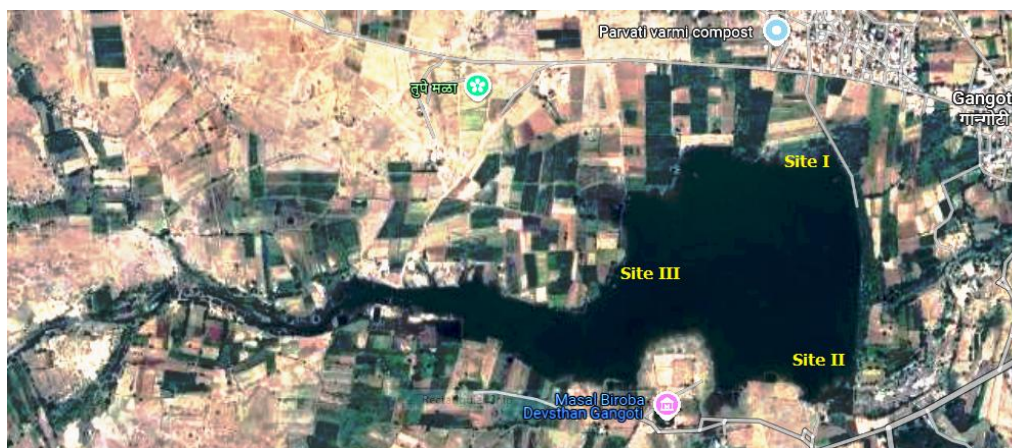


Figure 1: Geographic location of Gangoti Dam and Sampling points (Source: Google maps)

Gangoti (Lat 17° 35' 15.88337" N, Long 74° 46' 2.00716" E) is a small village located in Man tehsil of Satara district in Maharashtra, India. The village comes under Pune division and is situated in the Desh or Paschim region of Maharashtra (Fig. 1). It is about 40 Km away from sub-district headquarters Dahiwadi and 105 Km away from district headquarter Satara. The total geographical area of village is 2654 hectares and it has a total population of 1,540. There are about 315 houses in gangoti village.

Gangoti dam is one of the major water reservoirs in the Man Tahsil and is located very near to the Gangoti village. Geographically it extends from Lat 17° 34' 46.95781" N, Long 74° 45' 45.81915" E from South to Lat 17° 35' 12.09083" N Long 74° 45' 44.34933" E towards the North. Towards the West side, it is extended up to Lat 17° 34' 57.64165" N, and Long 74° 44' 57.77458" E (Fig 1).

Gangoti dam is an earth-fill dam (also called earthen dam) and was constructed as a simple embankment of well-compacted earth. It is entirely constructed of one type of material along with a drain layer to collect seep water. It is a storage dam and used to store the water during the rainy season. The dam water is major site of aquaculture and was also used for fishing by the local communities. Main wall of the dam is constructed in the south-north direction with an approximate length of about 1 Km. Average depth of the dam is about 10 m and has the water storage even in summer also. Local inhabitants from the adjoining villages such as Virkarwadi, Shirtav, and Panvan are benefitted by dam water directly for human and domestic animals along with its percolation for the agriculture practices (Fig 2).



Figure 2: The Gangoti Dam at Gangoti in Tal. Man, Dist. Satara

Site I: It is located towards the south side of the dam and has rocky substratum of the basalt rocks. A diversion canal was constructed at this site mainly for the release of extra water during the rainy season. This site shows dominance of the xerophytes along with other plants such as Indian Beech Tree, Indian Gum Arabic, Common Lantana, Tanner's Cassia, etc. (Fig. 3)

Site II: This is situated towards the north side of the main wall of the dam and has sparse vegetation of Indian Beech Tree, Indian Gum Arabic, Neem tree, Mango, Indian jujube, etc. (Fig. 4).

Site III: It located towards the west side of the dam and has sparse vegetation of Indian jujube, Chinese chaste tree, Common Lantana, Indian Gum Arabic, Giant milkweed, etc. During summer, the exposed substratum of this site shows heavy growth of grass and many goats, sheep, and cattle used exposed region of this for grazing (Fig 5).



Figure 3: Aquatic Habitat at Site I at Gangoti Dam



Figure 4: Freshwater Ecosystem at Site II at Gangoti Dam



Figure 5: Aquatic ecosystem at Site III at Gangoti Dam

Water Sampling:

The present study was carried out monthly for a period of twelve months, i.e. from August 2024 to September 2025. Surface water samples were collected monthly in a clean, leak-proof plastic container. Water samples were collected in triplicate from each station, and average value for each variable was reported. Water samples were analysed for pH, Temperature, Turbidity, Colour, Total Dissolved solids (TDS), Dissolved oxygen (DO), Biochemical oxygen demand (BOD), Carbon dioxide (CO₂), Chemical oxygen demand (COD), Orthophosphate (O-PO₄), Nitrate–nitrogen (NO₃–N), and Silicates (SiO₄-Si) following the standard methods prescribed by Clesceri et al (2008) in American Public Health Association (APHA) (Table 1). All colorimetric measurements were done on ERMA INC (AE 11D) colorimeter.

Results and Discussion:

The average values and seasonal variations of water quality variables at Gangoti dam for the period of 12 months (October 2024 to September 2025) are presented in Table 1. Graphical representation of water quality parameters are presented in Figure 6 to 17.

Table 1: Water quality parameters at Gangoti dam.

Water quality variable	Abbreviations and units	Pre-monsoon	Monsoon	Post-monsoon
pH	pH	8.05±0.07 (7.95-8.11)	7.49±0.06 (7.41-7.54)	7.67±0.14 (7.54-7.83)
Temperature	T (°C)	25.84±0.2 (25.56-26.05)	24.45±0.25 (24.22-24.68)	24.55±0.05 (24.47-24.59)
Turbidity	(NTU)	1.43±0.09 (1.33-1.55)	8.15±0.37 (7.65-8.55)	16.84±2.50 (13.67-19.58)
Total Dissolved solids	TDS (mg/l)	183.65±12.54 (168.74-199.26)	151.14±12.42 (138.47-166.59)	165.46±7.98 (155.97-175.46)
Dissolved oxygen	DO (ml/l)	5.21±0.22 (4.99-5.46)	5.65±0.04 (5.61-5.69)	5.72±0.03 (5.69-5.76)
Biochemical oxygen demand	BOD (ml/l)	3.35±0.21 (3.18-3.64)	4.17±0.06 (4.08-4.21)	4.12±0.15 (3.94-4.28)
Carbon dioxide	CO ₂ (mg/l)	23.10±1.16 (21.74-24.17)	26.97±1.32 (25.26-28.26)	25.04±2.27 (22.18-27.33)
Chemical oxygen	COD (mg/l)	54.68±1.58 (52.92-56.75)	25.66±2.95 (23.18-29.48)	27.37±2.21 (25.29-30.43)
Orthophosphate	O-PO ₄ (µg/l)	1.17±0.09 (1.09-1.28)	0.83±0.07 (0.78-0.93)	0.16±0.02 (0.14-0.18)
Nitrate–nitrogen	NO ₃ -N (µg/l)	15.5±0.86 (14.22-16.05)	18.33±0.94 (17.26-19.53)	12.07±1.07 (11.30-13.57)
Silicates	SiO ₄ -Si (µg/l)	35.53±2.99 (32.26-39.03)	34.02±3.63 (30.47-39.03)	48.05±5.40 (40.33-52.21)

All values are Mean ± SD

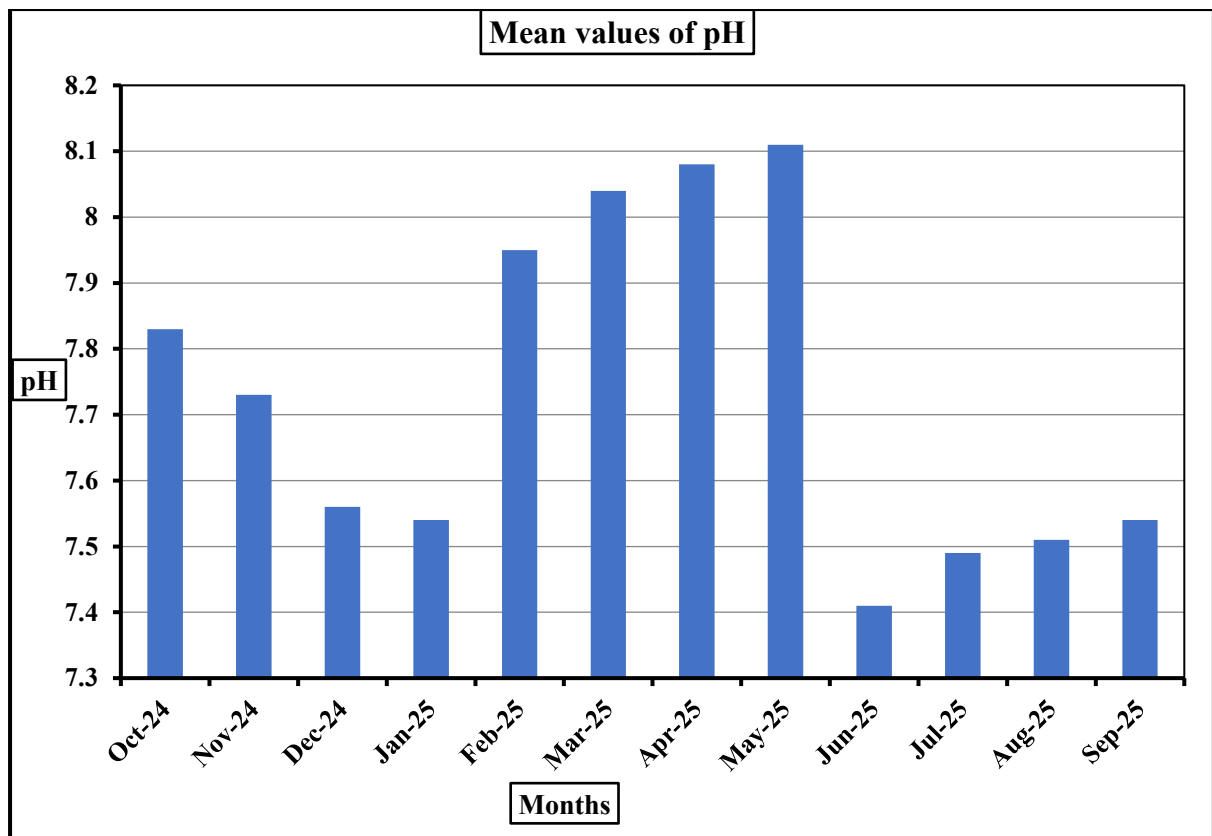


Figure 6: Graphical representation of pH at Gangoti dam.

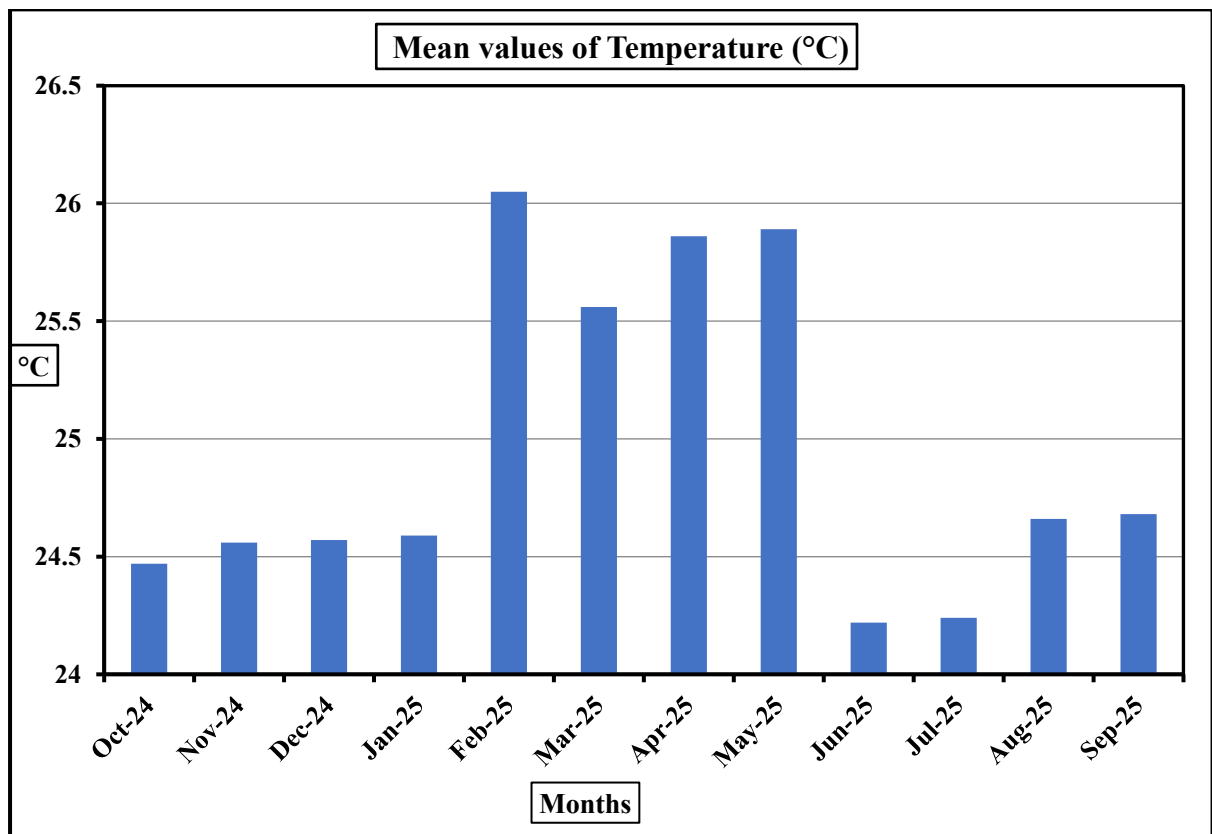


Figure 7: Graphical representation of Temperature at Gangoti dam

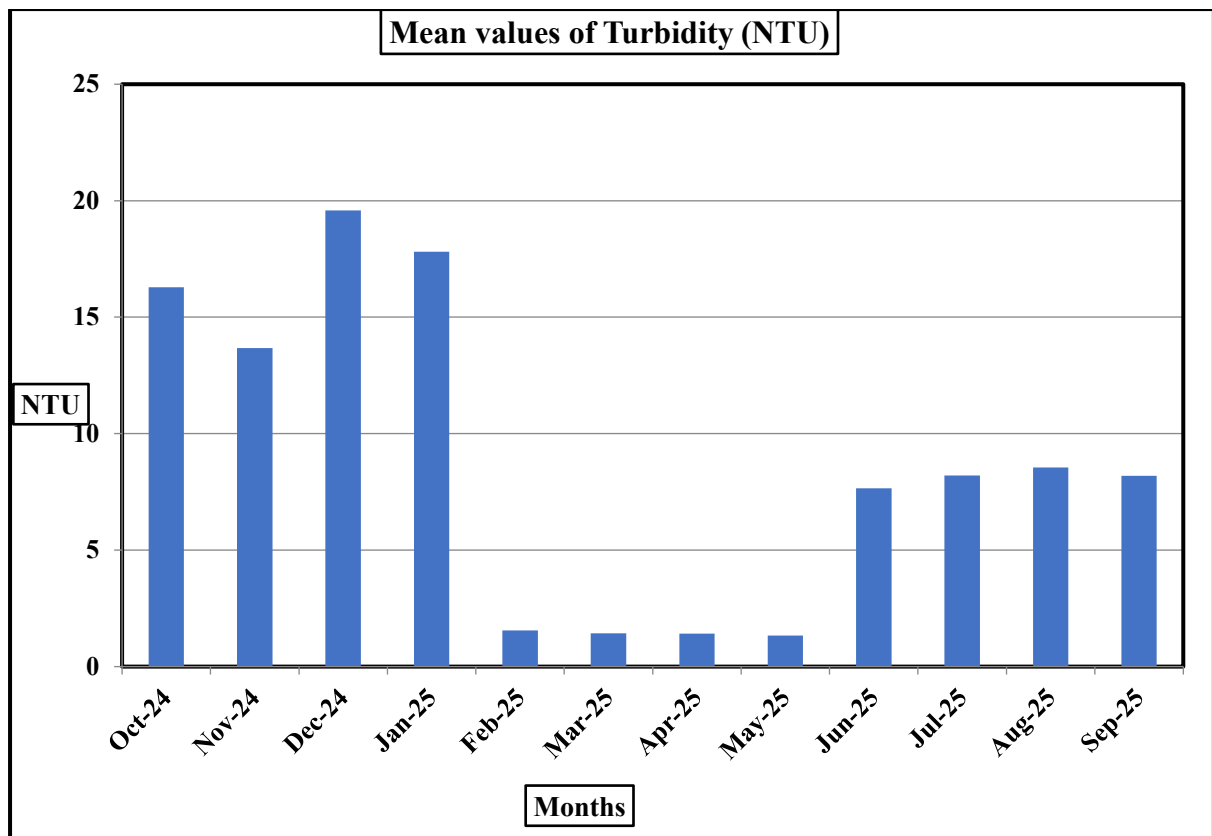


Figure 8: Graphical representation of Turbidity at Gangoti dam.

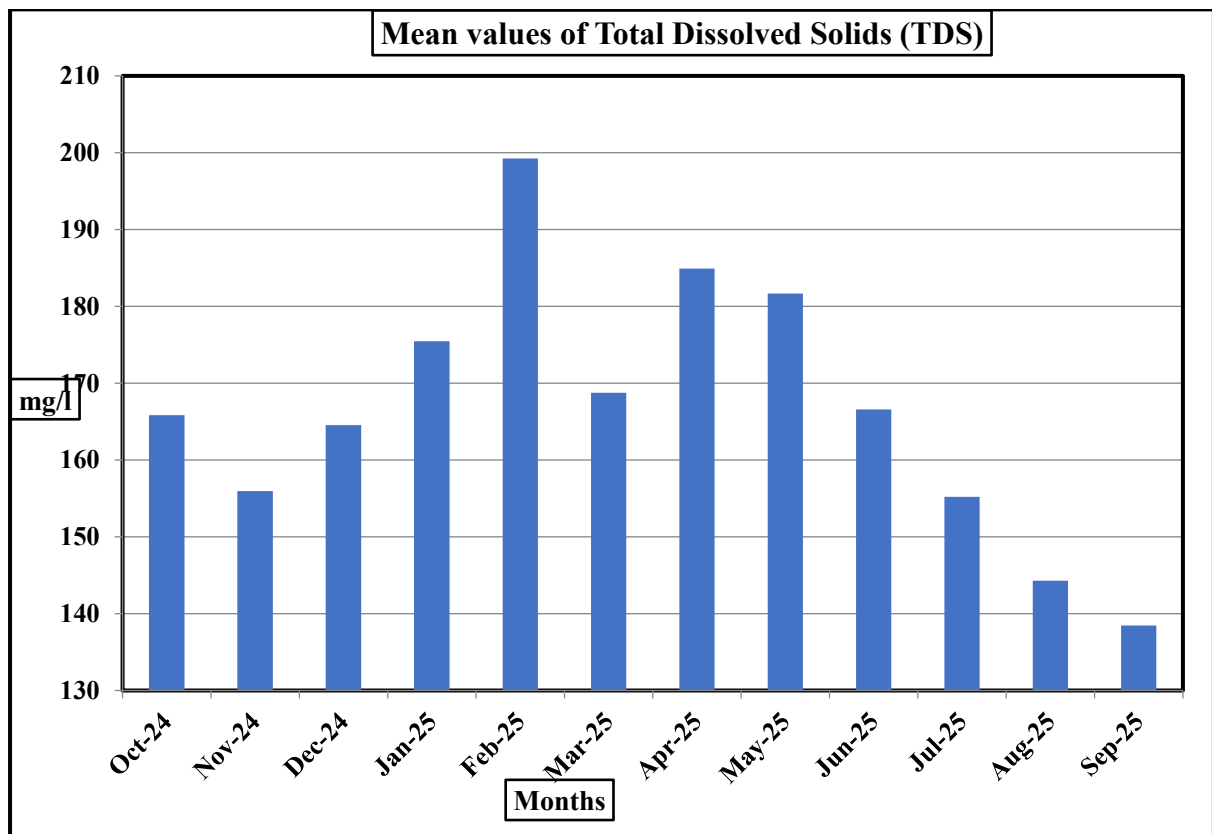


Figure 9: Graphical representation of Total Dissolved Solids at Gangoti Dam.

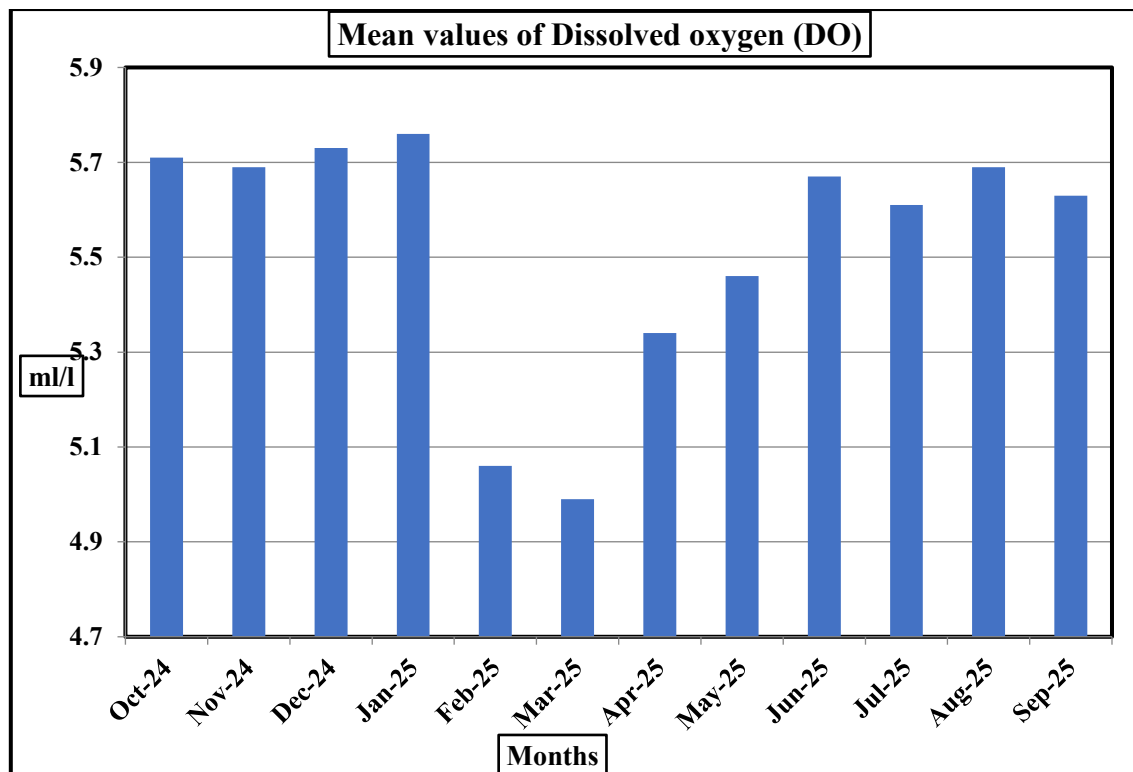


Figure 10: Graphical representation of Total Dissolved Oxygen at Gangoti Dam.

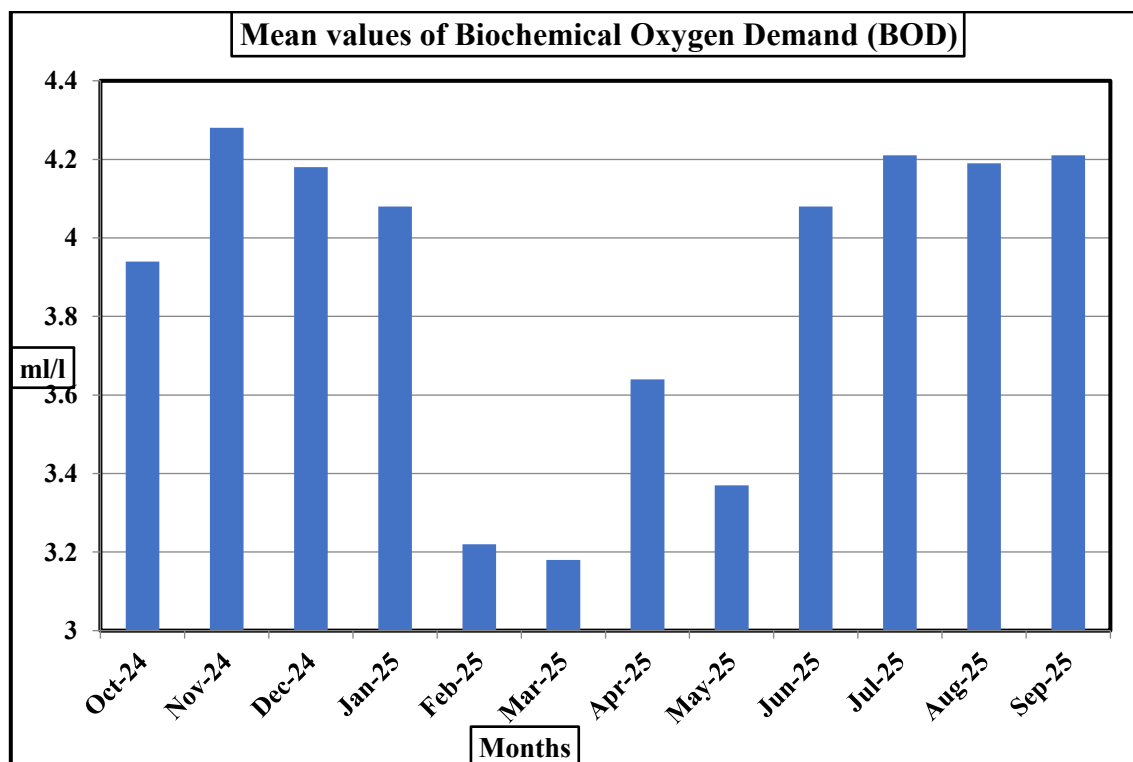


Figure 11: Graphical representation of Biological Oxygen Demand at Gangoti Dam.

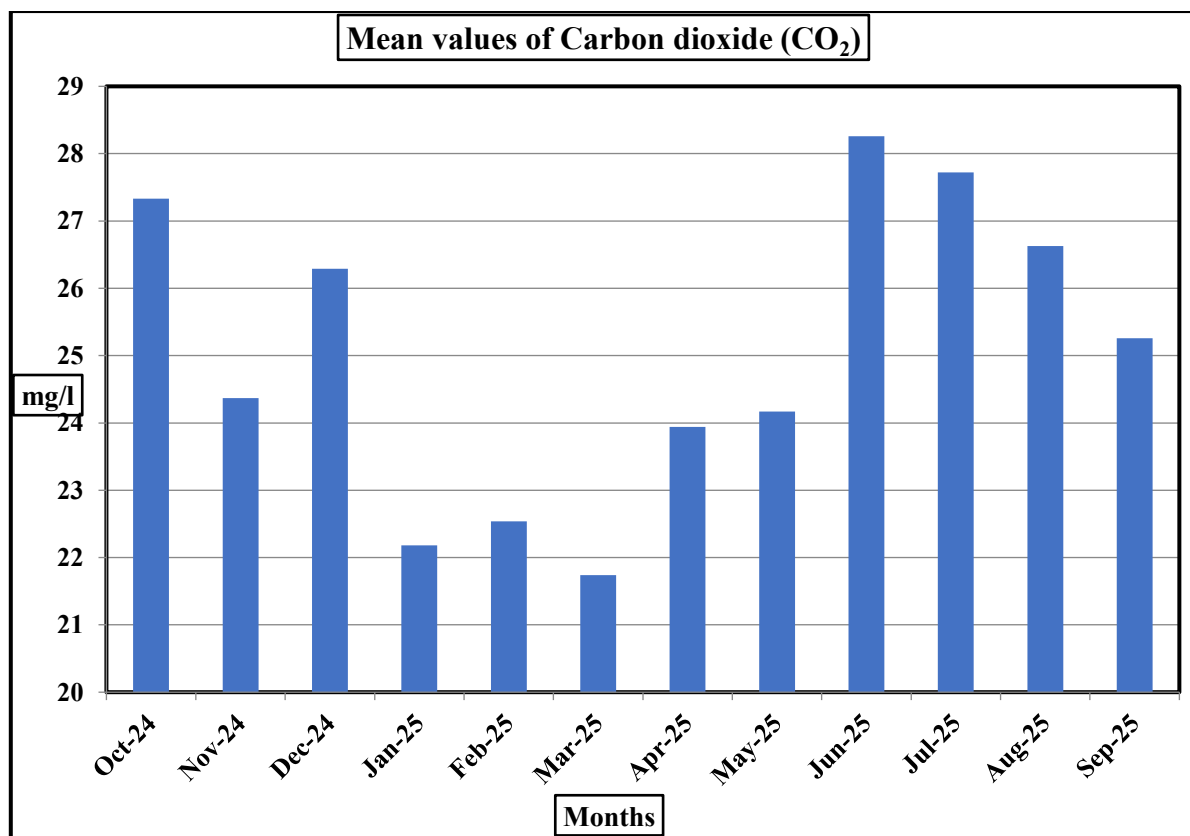


Figure 12: Graphical representation of free Carbon-dioxide at Gangoti Dam.

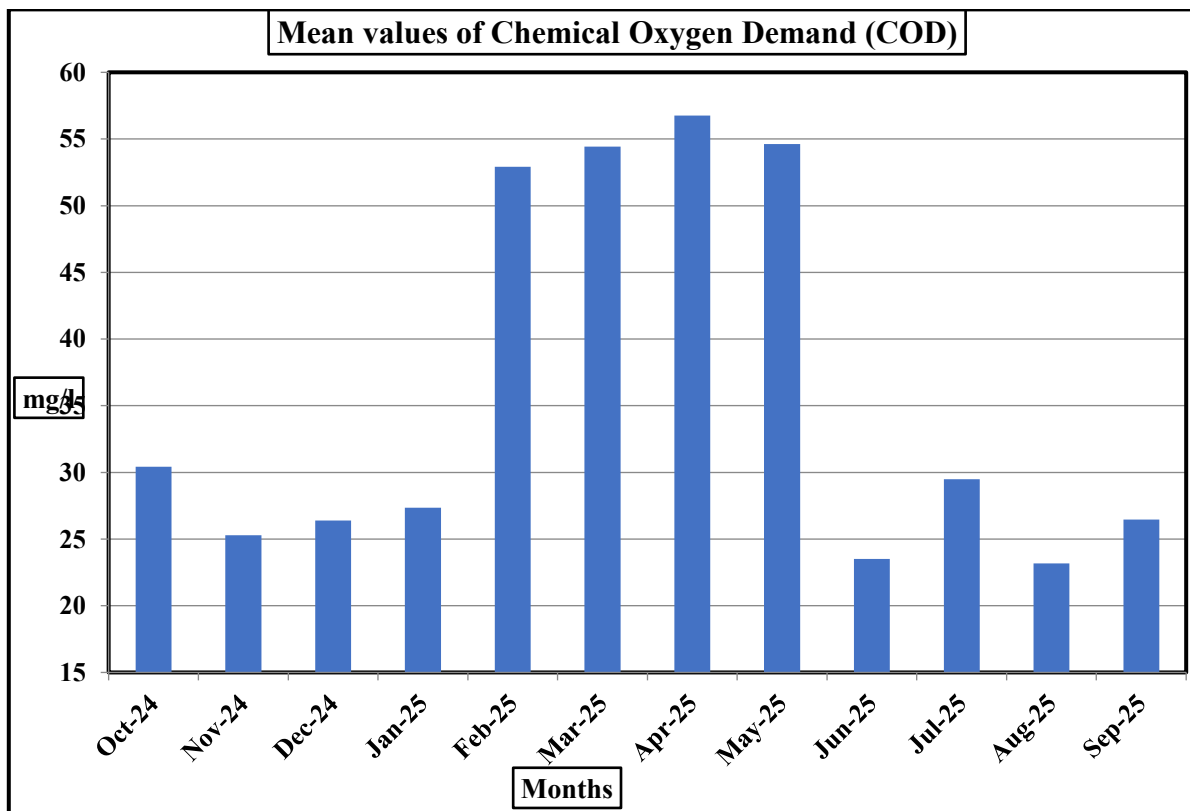


Figure 13: Graphical representation of Chemical Oxygen Demand at Gangoti Dam.

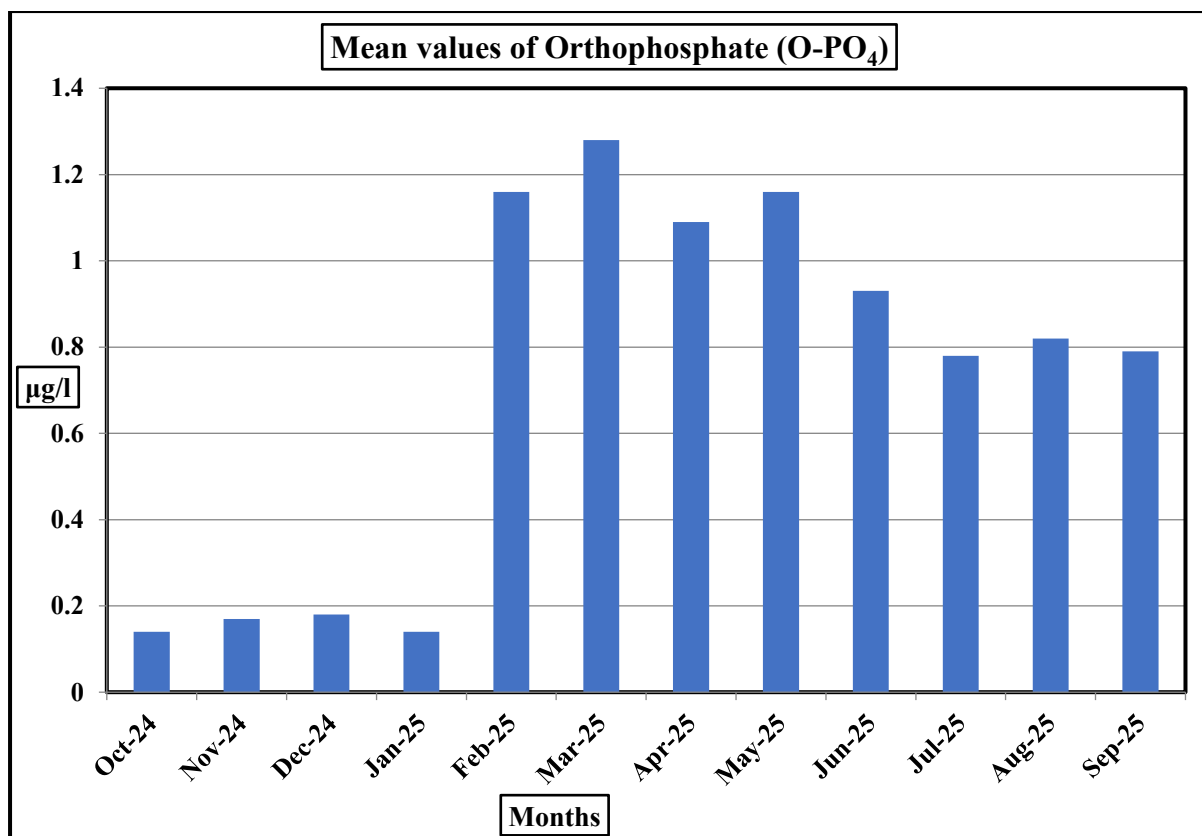


Figure 14: Graphical representation of Orthophosphate at Gangoti Dam.

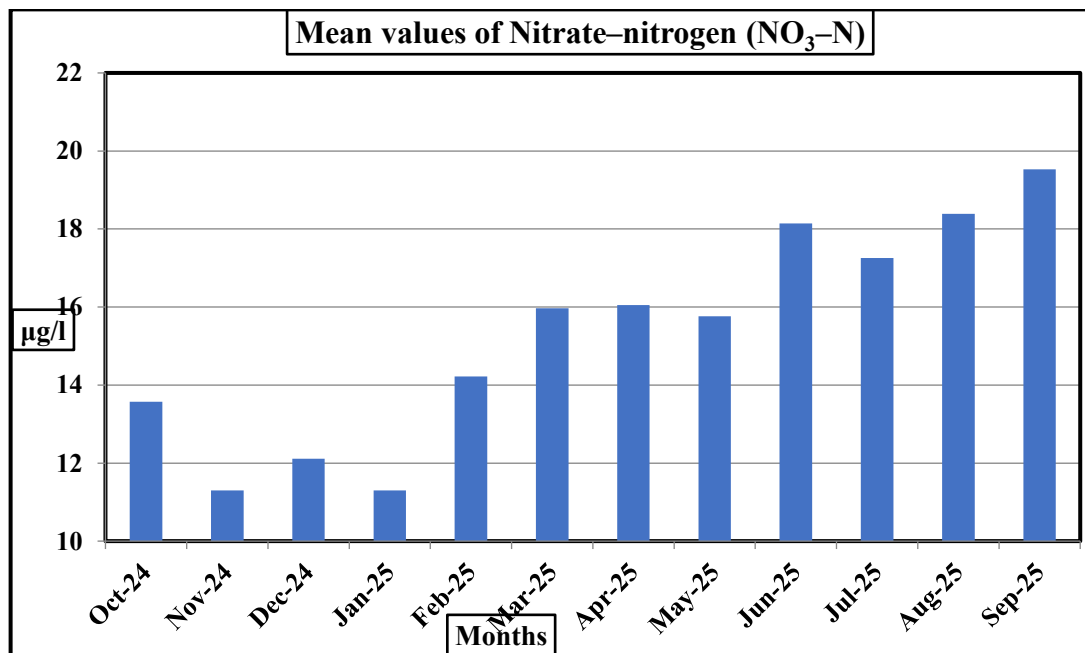


Figure 15: Graphical representation of Nitrate - nitrogen at Gangoti Dam.

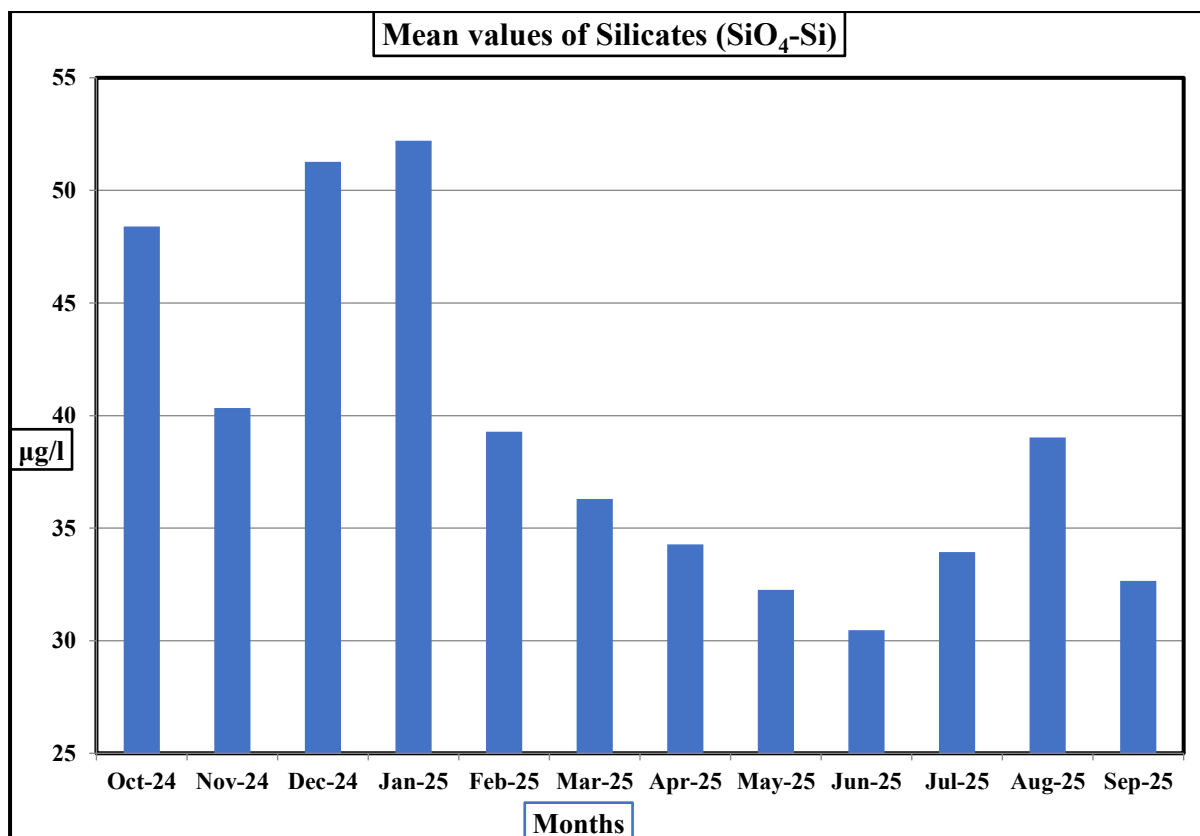


Figure 16: Graphical representation of Silicate at Gangoti Dam.

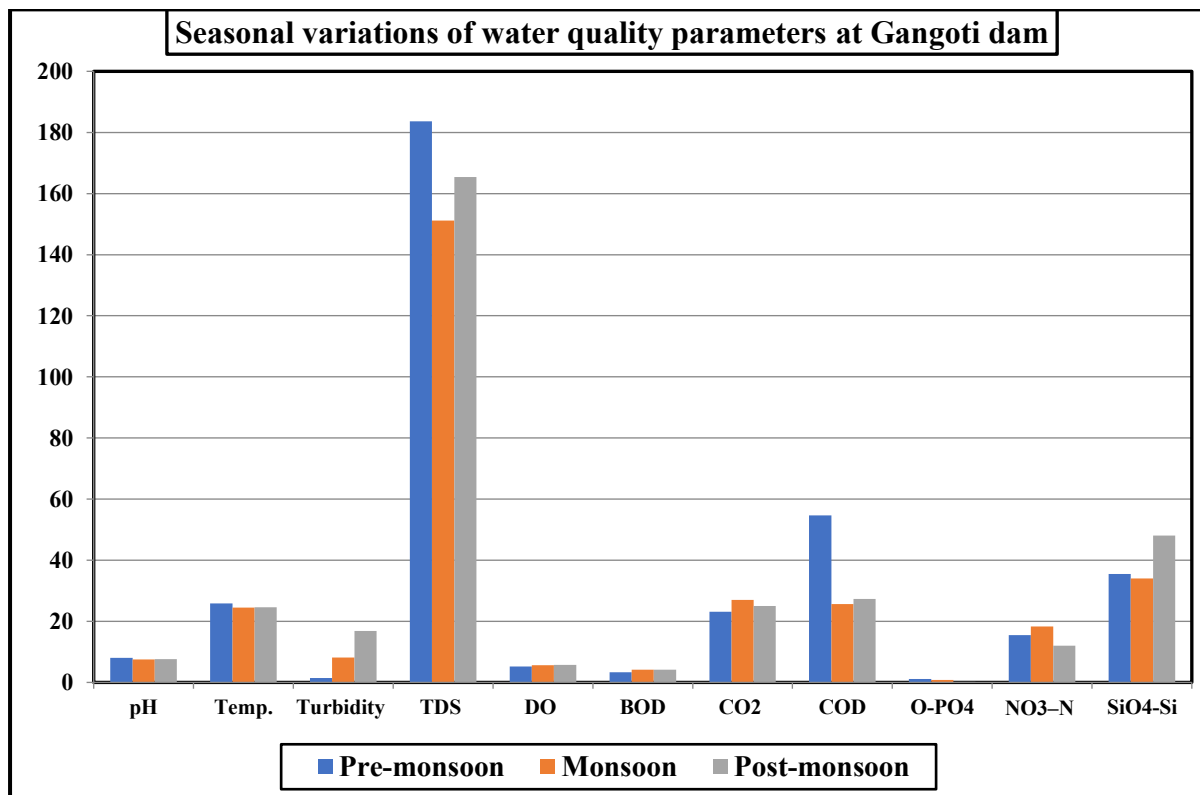


Figure 17: Graphical representation of seasonal variations in physico-chemical parameters at Gangoti Dam.

1. pH

The pH of the dam water ranged from 7.41 to 8.11 with an average value of 7.74 (Fig. 6). High value of pH in May is due to the reduced rate of photosynthetic activity, assimilation of carbon dioxide and bicarbonates, pre-monsoonal rainfall, which may dilute the alkaline substances or the dissolution of the atmospheric carbon dioxide. This suggests that carbon dioxide, carbonate–bicarbonate equilibrium is affected more due to change in physico-chemical condition. Safe ranges of pH for drinking water are from 6.5 to 8.5 for domestic use and living organisms need. Pollution can modify the pH of water, which can damage animals and plants that live in the water (Nayla, 2019).

Freshwater resources generally have a pH ranging between 6 and 9. The presence of dissolved substances from bedrock, soil and other materials greatly affect the pH of streams. Changes in pH impact many aspects of water chemistry (UNEP/WHO, 1996).

A pH of 6.5-8 is generally considered ideal for most freshwater. The value of pH decreased in the dam is attributed to the increment of organic matter load to the dam ecosystem. The pH of the dam is within the permissible limits of for drinking, recreation, agricultural and aquatic life water use (6.5-8.5/9) (Worako *et al.*, 2015).

2. Temperature

The water temperature of Gangoti dam varied between 24.22 and 26.05°C with an average value of 24.95°C to the dam system. The mean temperature recorded for pre-monsoon, monsoon and post-monsoon is 25.84°C, 24.45°C, and 24.55°C respectively (Fig. 7)

Water temperature is a limiting factor for aquatic life as it controls the rate of metabolic and reproductive activities, thereby affecting life cycles. Fluctuation in the water temperatures may results in speed up, slow down, malfunction, or stop altogether the metabolic activities. Water temperatures can fluctuate seasonally, daily, and even hourly, especially in smaller sized bodies of water. Temperature affects the concentration of dissolved oxygen in a water body because oxygen is more easily dissolved in cold water (UNEP/WHO, 1996).

In freshwater resources, variation in temperature depends on location and season, but generally 15-25°C is optimal for many aquatic organisms. A distinct seasonal variation of the temperature was noted during the entire period of the study. Higher temperature observed during pre-monsoon is correlated to the high solar radiation, increased evaporation, and low water level. Lower temperature during monsoon could be due to precipitation and freshwater influx (Singh *et al.*, 2024).

3. Turbidity

The turbidity value ranged between 1.33 and 19.58 NTU with an average value of 8.81 NTU (Fig. 8). Turbidity is the cloudiness of water and is a measure of the ability of light to pass through water. It is caused by suspended material such as clay, silt, organic material, plankton, and other particulate materials in water.

Moderately low levels of turbidity may indicate a healthy, well-functioning ecosystem. However, higher levels of turbidity pose several problems for water systems. Suspended soil particles may carry nutrients, pesticides, and other pollutants throughout a water system, and can bury eggs and benthic critters when they settle. Turbid waters may also be low in dissolved oxygen. High turbidity

may result from runoff containing sediment or from nutrient inputs that cause plankton blooms (UNEP/WHO, 1996).

Low level of turbidity (less than 10 NTU) is supposed to be optimal for the freshwater environment. The turbidity of the dam water is higher than the permissible limit <5 NTU WHO (2011) stated that drinking water is best consumed with NTU less than 1NTU for health purposes. Higher values of turbidity during post-monsoon are attributed to the waste discharge (World Water Quality Alliance, 2021).

4. Colour

In present study, recorded colour of the surface water is clear and blue during the post-monsoon, which becomes brackish red during monsoon, and slightly greenish during pre-monsoon.

Colour in water is primarily a concern of water quality for aesthetic reason. Coloured water give the appearance of being unfit to drink, even though the water may be perfectly safe for public use. Colour of the water body can indicate the presence of organic substances, such as algae or humic compounds. In recent times, colour has been used as a quantitative assessment of the presence of potentially hazardous or toxic organic materials in water. Colour is vital as most water users, be it domestic or industrial, usually prefer colorless water. Determination of colour can help in estimating the costs related to discoloration of the water (Sivudu *et al.*, 2023).

Clear and blue colour of dam water during post-monsoon is attributed to the low levels of dissolved and suspended materials, whereas during monsoon, as a result of surface runoff, colour might be changed to brackish red due to higher levels of suspended particles. Greenish colour observed during pre-monsoon is correlated to the water rich in phytoplankton and other algae. The colour of freshwater dam water can vary significantly depending on factors like dissolved and suspended materials, algae, and even the type of rocks in the watershed (Wang *et al.*, 2022).

5. Total Dissolved Solids (TDS)

The TDS value ranged between 138.47 and 199.26 mg/l with an average value of 166.75 mg/l (Fig. 9).

Nayla (2019) reported that; solids occur in water either in solution or in suspension. These two types of solids can be identified by using a glass fiber filter that the water sample passes through. By definition, total dissolved solids (TDS) are the residue left in a small dish after evaporation (at 103°C to 105°C) of the filtered portion of the water. They are helpful to the operators of the wastewater treatment plant because they roughly approximate the amount of organic matter existing in the total solids of wastewater, activated sludge, and industrial wastes.

The principal constituents of TDS are usually calcium, magnesium, sodium, and potassium cations and carbonate, hydrogen carbonate, chloride, sulfate, and nitrate anions (Gorde and Jadhav, 2013). Generally, concentration of TDS less than 500 mg/l is most suitable for the aquatic life and maintains a good water quality. The highest TDS value (183.65 ± 12.54) was recorded during the pre-monsoon, particularly in the month of February 2025 is due to the overall waste discharges from the village and nearby human settlements. The value of study agrees with the former research result

registered by Worako (2015) for TDS (455.6 mg/l) for the Lake Hawassa which is one of the Major Ethiopian Rift Valley Lakes.

6. Dissolved oxygen (DO)

In present study, concentration of DO is fluctuated from 4.99 to 5.76 mg/l with an average of 5.53 mg/l to the dam system. Seasonal variations of mean values of DO recorded at Gangoti dam were 5.21 ± 0.22 , 5.65 ± 0.04 , and 5.72 ± 0.03 mg/l for pre-monsoon, monsoon, and post-monsoon respectively (Fig. 10).

Gorde and Jadhav (2013) noted that; summer is usually the most crucial time for DO levels because water flows tend to decrease and water temperatures tend to increase. In general, DO levels less than 3 mg/l are stressful to most aquatic organisms and majority of fish die at 1-2 mg/l. Water with DO levels from 0.5-2 mg/l are considered hypoxic, and waters with less than 0.5 mg/l are anoxic (depleted of dissolved oxygen).

The absence of enough amount of oxygen in water can lead to death of adults and juveniles, reduction in growth, failure of eggs/larvae to survive, change of species present in a given water body. The hypoxic condition in water body ($DO < 3 \text{ mg/l}$) causes reduced cell functioning and disrupts circulatory fluid balance in aquatic system, eventually leading to death (Tokatli, 2020).

DO level of 6 mg/l or more is most desirable for aquatic life. Moderate values of DO recorded in this study are attributed to the photosynthetic activity by aquatic plants and algae and to the lower temperature. Results on DO were in agreement with the findings of Kalaitzidou et al (2023) during water quality evaluation of dam reservoir water in multiple areas of Greece; and Fashagba et al (2024) during evaluation of the water quality of the Keddara Dam (Algeria).

7. Biochemical oxygen demand (BOD)

The BOD value ranged between 3.18 and 4.28 mg/l with an average value of 3.88 mg/l. It is noted that comparatively higher BOD values were recorded during monsoon (4.17 ± 0.06 mg/l) and post-monsoon (4.12 ± 0.15 mg/l) than the pre-monsoon (3.35 ± 0.21 mg/l) (Fig. 11).

BOD represents the amount of oxygen consumed by bacteria and other microorganisms while they decompose organic matter under aerobic (oxygen is present) conditions at a specified temperature. BOD indicates the level of organic pollution in water, and it is a crucial parameter for assessing water quality and the effectiveness of wastewater treatment. A high BOD value suggests a higher amount of organic matter, which leads to increased microbial activity and oxygen consumption, potentially harming aquatic life and making the water unsuitable for various uses (Nayla, 2019).

Fuquay et al (2011) concluded that; BOD of water is significant in to assess aquatic ecosystem health; evaluating effectiveness of wastewater treatment; indicator of water quality; monitoring of pollution sources; to determine the rate of respiration in living beings and the respiration rate of sewage, sludge, soil, and garbage; and to measure oxygen consumption of cell cultures in medical and pharmaceutical industries.

BOD levels of 2 mg/l or less is considered as ideal for the sustainance of freshwater ecosystem. Low BOD values were due to low organic pollution, and distribution of domestic sewage into the dam (Sayyad, 2020). High BOD values were attributed to the high oxygen demanding substances disposed

to the dam water by surface runoff and utilization of oxygen for its oxidative biodegradation (Saima *et al.*, 2024).

8. Carbon dioxide (CO₂)

In present study, significantly high values of free CO₂ were reported during all seasons. Except the slightly lower values observed during pre-monsoon (23.10 ± 1.16 mg/l), exceptionally higher values were recorded both during monsoon (26.97 ± 1.32 mg/l) and post-monsoon (25.04 ± 2.27 mg/l) (Fig. 12).

Surface waters normally contain less than 10 mg free CO₂ per liter, while some groundwaters may easily exceed that concentration. The CO₂ content of water may contribute significantly to corrosion. Recarbonation of a supply during the last stages of water softening is a recognized treatment process (APHA, AWWA, WEF, 2023).

Free CO₂ in freshwater is crucial for aquatic ecosystems because it serves as the primary carbon source for aquatic plants and influences pH and water chemistry. Aquatic plants, including algae and rooted plants, utilize dissolved CO₂ during photosynthesis to produce their own food and release oxygen. CO₂ also plays a role in determining the pH of the water, with higher levels contributing to acidification (Udayashankara *et al.*, 2013).

Excessive free CO₂ in freshwater can lead to acidification and harm the aquatic life by reducing the availability of oxygen and altering the pH of the water. Specifically, elevated CO₂ can decrease the growth rates of freshwater biota, impact fish, and affect the overall ecosystem health. Acidification of freshwater resulted due to high concentrations of CO₂ can negatively impact aquatic life and water quality. Excess CO₂ can reduce pH, affect oxygen availability, and even cause corrosion of infrastructure (Cupp *et al.*, 2020).

High values of free CO₂ during monsoon and post-monsoon was attributed to the pollution of dam water with surface runoff with nutrients, domestic waste and sewage, and biological breakdown of organic matter (Cymes and Glinska-Lewczuk, 2016; Tecklie *et al.*, 2024).

9. Chemical Oxygen Demand (COD)

The COD values ranged from 23.18 to 56.75 mg/l with an average value of 35.9 mg/l for the dam water system. Seasonal variations of mean values of COD recorded at Gangoti dam were 54.68 ± 1.58 , 25.66 ± 2.95 , and 27.37 ± 2.21 mg/l for pre-monsoon, monsoon, and post-monsoon respectively. Exceptionally higher values (54.68 ± 1.58 mg/l) were observed during pre-monsoon (Fig. 13).

COD is a measure of the amount of oxygen required to chemically oxidize the organic matter and some inorganic matter in a water sample. It's an indirect measure of the amount of oxidizable pollutants in the water, indicating the potential for oxygen depletion by these substances. COD is often used to monitor water treatment plant efficiency where a strong oxidizing agent, under acidic conditions, can fully oxidize almost any organic compound to carbon dioxide. The COD is the amount of oxygen consumed to chemically oxidize organic water contaminants to inorganic end products (Ozzie, 2022).

Nayla (2019) described that; COD is an important water quality parameter that measures all organics: the biodegradable and the non-biodegradable substances and is used mainly in wastewater

treatment. It is a chemical test using strong oxidizing chemicals (potassium dichromate), sulfuric acid, and heat, and the values of COD are always higher than BOD values for the same sample.

COD also provides an index to assess the effect of discharged wastewater on the receiving environment. Higher COD levels represent the presence of greater amount of oxidizable organic material in the sample, the degradation of which will again lead to hypoxic conditions in the water body. The ratio of BOD to COD indicates the percent of organic material in water that can be degraded by natural microorganism in the environment (Sivudu *et al.*, 2023).

COD often is used as a measurement of pollutants in wastewater and natural waters. It is an important and rapidly measured variable for characterising water bodies, sewage, industrial wastes and treatment plant effluents. Recognized as an indirect method for assessing total organic content, COD finds widespread use in monitoring municipal waste within water bodies. Elevated COD levels in water bodies render them unsuitable for fisheries and agricultural activities (Kapani *et al.*, 2024).

Higher values of COD recorded in present study were attributed to the decrease in freshwater inflow and domestic sewage (Bhateria and Jain, 2016). Low COD recorded during the monsoon is correlated to the freshwater influx by the monsoonal runoff (Wu *et al.*, 2017; Kapani *et al.*, 2024).

10. Orthophosphate (O-PO₄)

In present study, concentration of O-PO₄ is fluctuated from 0.14 - 1.28 µg/l with an average of 0.72 µg/l in dam system. Seasonal variations of mean values of O-PO₄ recorded at Gangoti dam were 1.17±0.09, 0.83±0.07, and 0.16±0.02 µg/l for pre-monsoon, monsoon, and post-monsoon respectively (Fig. 14).

Yuni *et al* (2024) reported that; in freshwater resources the phosphate content increases generally during monsoon due to addition of large quantity of phosphorus sources such as household waste containing detergents, agricultural activities using fertilizers, household activities residues, and fish or livestock feed leftovers leaching into water bodies. These factors are phosphorus sources promoting fertility in waters.

Groundwaters rarely contain more than 0.1 mg/l phosphorus unless they have passed through soil containing phosphate or have been polluted by organic matter. Phosphorus compounds are present in fertilisers and in many detergents. Consequently, they are carried into both ground and surface waters with sewage, industrial wastes and storm run-off. High concentrations of phosphorus compounds may produce a secondary problem in water bodies where algal growth is normally limited by phosphorus. In such situations the presence of additional phosphorus compounds can stimulate algal productivity and enhance eutrophication processes (UNEP/WHO, 1996).

Higher content of O-PO₄ recorded during pre-monsoon was may be due to domestic detergents, industrial sewage effluents, and surface runoff (Tiwari and Tiwari, 2022). Moderate O-PO₄ noted during remaining period of investigation was correlated to the utilization of phosphate by phytoplankton (Singodia *et al.*, 2024).

11. Nitrate–nitrogen (NO₃-N)

The NO₃-N values from surface waters ranged from 11.3 to 19.53 µg/l with an average value of 15.3 µg/l. Seasonal variations of mean values of NO₃-N recorded at Gangoti dam were 15.5±0.86, 18.33±0.94, and 12.07±1.07 µg/l for pre-monsoon, monsoon, and post-monsoon respectively. Except

the higher values (19.53 µg/l) of NO₃-N recorded during monsoon, during the remaining study period, moderate values were recorded (Fig. 15).

Excess nitrate in freshwater cause several negative impacts on both aquatic ecosystems and human health. It can lead to eutrophication, harmful algal blooms, and reduced oxygen levels in the water, harming aquatic life. In addition, elevated nitrate in drinking water can pose health risks, especially for infants, and may contribute to the formation of nitrosamines, which are potential carcinogens (Tokatli, 2020).

According to Sayyad (2020); sources of nitrate in groundwater and surface water includes agrochemicals, surface runoff from irrigated lands, septic tanks, leakage from drainage networks, livestock wastes, manure storage, landfills, urban fertilizer use, industrial wastewater, sludge disposal, etc. In surface water, nitrate is a nutrient taken up by plants and converted into cell protein. The growth stimulation of plants, especially of algae may cause objectionable eutrophication (CPCB, 2013).

A high concentration of nitrate in surface water can stimulate the rapid growth of the algae which degrades the water quality. Nitrates can enter the groundwater from chemical fertilizers used in the agricultural areas. Excessive nitrate concentration (more than 10 mg/l) in drinking water causes an immediate and severe health threat to infants. The nitrate ions react with blood hemoglobin, thereby reducing the blood's ability to hold oxygen which leads to a disease called blue baby or Methemoglobinemia (Tiwari and Tiwari, 2022).

For freshwater, nitrate concentration less than 10 mg/l is ideal but values more than this can be harmful to infants. Higher NO₃-N concentration recorded during monsoon is attributed to the freshwater inflow, terrestrial runoff, and land drainage. Findings of the study are in line with the results of Vankore and Nikam (2024) in the surface water of Kalamavadi dam, on Dudhaganga river near Radhanagari in the State of Maharashtra, India; and Devi and Anandhi (2009) in surface water of Madhavara Lake in Bangalore, India.

12. Silicates (SiO₄-Si)

Exceptionally higher silicates in the range of 40.33-52.31 µg/l were recorded during post-monsoon as compared to the monsoon (30.47-39.03 µg/l) and post-monsoon (40.33-52.21 µg/l) (Fig. 16).

Silicates in freshwater primarily originate from the weathering of silicate minerals and rocks. These minerals, like feldspar, mica, and clay, are common in both detrital sedimentary rocks and igneous rocks, and their breakdown releases silicon into the water. Other sources include atmospheric deposition, benthic metabolism, biogenic silica, and the dissolution of riverine particulate matter (Guangxin *et al.*, 2024).

Silicates are a common component of fresh water and are typically present in low to moderate concentrations. They are not inherently toxic to fish and invertebrates, but can contribute to diatom growth. The normal concentration of silicates in freshwater ranges from 1 to 30 mg/l whereas in some areas it may exceeds as much as 100 mg/l. Higher silicate concentration recorded during post-monsoon might be due to land drainage, and silicates leached out from rocks (Rui *et al.*, 2020). Relatively lower silicates reported during monsoon and pre-monsoon were due to biological removal/uptake of silicates by phytoplankton (Wanjari and Tanpure, 2020).

Result on the monitoring of water quality of Gangoti dam reveals that, water quality parameters shows seasonal variation. Data on monthly assessment of the water quality variables is within the permissible limits of the water quality standards. The quality of water deteriorates towards the reservoir bed and also upstream and downstream of the reservoir due to several factors such as duration of storage, the nutrient load, the depth of reservoir, the turbidity and temperature.

Several natural factors (sedimentation, runoff, and erosion, etc) and anthropogenic factors (agricultural activities such as use of fertilizers, pesticides, etc) affect the water quality of the dam. Additionally, the duration of water storage, the nutrient load, and the depth of the reservoir can all impact water quality. Also climate, geology, and the overall health of the ecosystem play a crucial role in maintaining the dam water quality.

Findings of the present study indicates that the Gangoti Dam's water quality parameters were within the WHO's permissible level, except for the total dissolved solids and chemical oxygen demand turbidity values. At present the water quality of the Gangaoti dam is excellent but in near future the ongoing anthropogenic activities in the catchment areas of the dam should not be neglected.

Summary and Conclusion:

Gangoti dam (17° 35' 0.35509" N, 74° 45' 31.5443" E) is one of the major fresh water reservoir located very near to the Gangoti village in Tal. Man, Dist. Satara of Maharashtra, India. It is an earthen dam and was constructed to store the water during the rainy season. The dam water is major site of aquaculture and was also used for fishing by the local communities.

Results of the present study indicate that at preset, the water quality of Gangoti Dam is excellent, but in future it will face an alarming threat of pollution from various sources and anthropogenic activities. Various factors contributing in the deterioration of the water quality of Gangoti Dam include pollution from various sources like industrial and agricultural runoff, untreated sewage, and improper waste disposal. Natural factors like sedimentation and changes in temperature also play a role, while anthropogenic factors like overuse of pesticides and fertilizers further degrade water quality.

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